Progress Report No. 7

Wetlands Ecology, SR 140

Dr. Richard R. Anderson, P.I.

Sept. 30, 1973

Biology Department

The American University

Washington, D.C. 20016

PROGRESS REPORT NO. 7

September 30, 1973

A. Title: ERTS-1 Data User Investigation of Wetlands Ecology, SR140

B. Principal Investigator: Dr. Richard R. Anderson, The American University, UN-006

C. Problems: none

D. Accomplishments during July, August, and September include:

1. A field trip was made to the southern (South Carolina - Georgia) test site for the purpose of looking at various tidal freshwater marshes and field checking swamps along the Santee River and at the northern end of Lake Marion in South Carolina. An additional purpose was to do preliminary field work in preparation for Skylab data anticipated to cover the area.

   Species composition within and outside the confines of the Savannah National Wildlife Refuge (north of the Savannah River in South Carolina) was ascertained in order to test the hypothesis that management areas can be distinguished from natural marsh areas because of vegetative differences and the existence of dikes. The managed area includes dry pools, with essentially upland vegetation, which are periodically burned and flooded, and wet pools in which a constant water level is maintained. The wet pools contain Nymphaea odorata (white water lily),

Brasenia schreberi (water shield), Nelumbo lutea (American lotus), Decodon verticillatus (swamp loosestrife), Panicum hemitomon (maidencane), Utricularia (bladder wort), and Polygonum (smartweed). The natural areas are dominated by Zizaniopsis miliacea (giant cut grass) with Typha sp. (cattail), Cladium jamaicense (sawgrass), Zizania aquatica (wild rice), and Panicum hemitomon (maidencane).

On the cloud-free ERTS images 1279-15280-7 (28 APR 73), 1261-15280-7 (10 APR 73), and 1243-15280-7 (23 MAR 73), the boundary of the Refuge is visible and the managed area is distinct from the natural marsh. A diked canal, experimental pools, and differences in dry and wet pools can also be distinguished. On images later in the growing season, 1297-15275-7 (16 MAY 73), and 1315-15274-7 (3 JUN 73) it is more difficult to determine the boundary.

2. Tidal information contained in ERTS-1 Investigation of Wetlands Ecology, Type II report, Nov. 1972 - May 1973, has been recalculated. Table 1 presents the corrected values for the Georgia, Ossabaw Island test site and Table 2 presents the corrected values for Charleston, S.C. Tide height and time of imagery for the 4/10/73 (1216-15280) image of the Georgia coast should read as follows: Fort McAllister (1) 1 hr. 21 minutes after low tide/0.8 ft., Sunbury (2) 1 hr. 52 minutes after low tide/1.4 ft., Kilkenny Creek (3) 2 hrs. 21 minutes

after low tide/2.1 ft. After recalculation of tidal data, the interpretation of the Georgia coast imagery remains unchanged. The approximate tide height in the Cooper River Estuary (Charleston, S.C.) is lowest on 8/19/72 when the riverine drainage channel was most easily delineated. Continued investigation of the water levels in the Cooper River Estuary show that the original average discharge before the building of the Lake Moultrie Dam was quite small -- perhaps 3,000 - 5,000 cfs. An increase to the present average of 15,000 cfs would explain the flooding of areas which are previously marsh. The proposed Corps of Engineers project will reduce the flow to an average of 3,000 cfs. It will be of considerable interest to observe the results of this water manipulation on the estuarine ecology.

3. Stanford Research Institute's ESIAC (Electronic Satellite Image Analysis Console) was used to analyze wetlands on repetitive ERTS imagery taken in the vicinity of Charleston, South Carolina, and Norfolk, Virginia.* The following frames were entered on the ESIAC console:

Dismal Swamp - North Carolina/Virginia

10/10/72	1079-15142-5,7
1/26/73	1187-15145-5,7
2/13/73	1205-15150-5,7
6/1/73	1313-15150,5,7

*Serebreny, S.M. 1973. Study of the Time Lapse Processing for Dynamic Hydrologic Conditions, Type II Progress Report.

Charleston, South Carolina - (1) Cooper and Wando Rivers, (2) Santee River

8/19/72	1027-15263-5,7
10/12/72	1081-15264-5,6
3/23/73	1243-15274-5,7
4/10/73	1261-15274-5,7
5/16/73	1297-15272-5,7
6/3/73	1315-15271-5,7

These data represent three time sequences, one over the Dismal Swamp, one over the Santee River Swamp, and one over the coastal marshes in the Charleston estuary and along the South Carolina coast.

ESIAC provides a sequential time-lapse capability for change detection. All images are carefully registered with the aid of a grid, and a 2-band color composite for each date is output on a CRT, usually with band 6 or 7 in red and band 4 or 5 in cyan. Gray scales may be added after the initial recording of partial images. Any number of composites can be cycled on the CRT display indefinitely, giving a good visual presentation of:

1. Seasonal change in light intensity of earth surface due to the sun angle and atmospheric attenuation.
2. Seasonal change in vegetation -- deciduous trees reflect strongly in the IR in spring, less strongly

in fall, and very weakly in winter when the leaves are off. Conifers, in contrast, show little seasonal change in reflectance.

3. Seasonal change in the visibility of water or wet soil underlying wooded swamps as deciduous trees shed their leaves.
4. Tidal effects as water height changes in coastal marshes.
5. Die-back of highly reflective fresh-water marsh vegetation to clearly delineate the landward boundary of the wetlands.

In order to examine the usefulness of a 2-band ratio technique as a possible method for separation of wetland from other scene elements, a number of sample measurements were made of large stands of vegetation and scene water using SRI's new two dimensional color space capability. These data are presently being studied.

4. Summer coverage of the Nanticoke River Marsh test site was received during the last week in September. Initial analysis of this imagery indicates the ability to detect seasonal changes in wetland vegetation. Overall scene brightness between winter and summer imagery may be a combined effect of sun angle and vegetation reflectance. However, reflectance patterns within the marsh between plant communities in the general categories of high marsh, low marsh, have changed distinctly.

Tidal information for the Nanticoke River area has aided interpretation. Comparison of the tide levels for the 9/1/73 and 8/30/73 imagery indicate a similar low water condition (ref. Table 3) . As previously reported floating ice is visible in the 9/1/73 imagery. A large sand bar is located immediately off Fishing Point, Fishing Bay. This sand bar was detected on the 9/1/73 imagery due to the combined effect of low tide and the presence of ice. The analysis of seasonal changes and tidal influence on image tonal patterns is continuing.

5. Analysis of Bendix 24 channel multispectral scanner data using the LARSYS remote terminal at GSFC is continuing. ERTS-CCT's have been ordered for both Georgia and North Carolina scenes. It is anticipated that these tapes will be utilized in the CRBE system at GSFC and possibly reformatted for use with LARSYS.

E. Significant Results: None during this period.

F. Papers presented: None during this period.

G. None

H. None

I. None

J. Request submitted for CCT's for ERTS frames 1079-15142, 1046-15324, and 1205-15150. Some black and white imagery was also ordered over the Hatchie Bottoms in Tenn.

TABLE 1: Tidal Information Correlated with ERTS Imagery
Ossabaw Island, Georgia

ERTS Image # and Date	Location #	Tidal Range (ft.)	Time Referenced to Tidal Stage	Approx. Tide Height (ft. above Mean Low Water)	Comments
1010-15322 8/2/72	*1	7.7	2 hrs 4 min after LW	2.1	Some cloud cover; drainage detail excellent; relatively little species difference.
	*2	8.3	2 hrs 37 min after LW	2.7	
	*3	8.7	3 hrs 4 min after LW	3.6	
1027-15265 8/19/72	1	4.5	12 min before LW	1.1	High, thin cloud cover over test site; drainage detail fair; almost no detail in marsh.
	2	6.1	19 min after LW	1.1	
	3	6.5	48 min after LW	1.4	
1046-15324 9/7/72	1	7.9	1 hr 58 min after HW	6.1	Relatively cloud-free; drainage detail obscurred in darker portions of marsh; marsh detail excellent.
	2	8.5	2 hrs after HW	6.4	
	3	8.9	2 hrs 17 min after HW	5.8	
1243-15280 3/23/73	1	6.8	1 hr 34 min before HW	5.5	Cloud-free; drainage detail excellent; marsh detail excellent.
	2	7.4	1 hr 40 min before HW	6.0	
	3	7.8	1 hr 15 min before HW	6.8	

* 1 - Ft. McAllister, Ga.; 2 - Sunbury, Ga.; 3 - Kilkenny Creek, Ga.

TABLE 2 : Tidal Information Correlated with ERTS Imagery and U-2 Photography Charleston, South Carolina

ERTS Image # and Date	Location #	Tidal Range (ft.)	Time Referenced to Tidal Stage	Approx. Tide Height (ft. above Mean Low Water)	Comments
1027-15263 8/19/72	*1	4.3	1 hr. 20 min after LW	1.2	Partial cloud cover; drainage detail excellent; both coastal and inland marsh detail poor.
	*2	4.4	2 min after LW	0.8	
	*3	2.3	1 hr. 45 min before LW	1.2	
U-2 Flight # 72-167, Frames 4214, 4215, 4240, 4241, 4242, 4274 9/22/72	1	6.2	13 min before LW	-0.1	Cloud-free; color IR -- a little underexposed. Excellent detail both coastal and inland.
	2	7.3	1 hr 09 min before LW	0.6	
	3	5.2	2 hrs 42 min before LW	2.2	
1081-15264 10/12/72	1	4.7	19 min before HW	5.5	Cloud-free; drainage detail poor along coast, good inland marsh detail.
	2	5.8	2 hrs 26 min before HW	5.1	
	3	3.7	3 hrs 3 min after LW	2.5	
1243-15274 3/23/73	1	4.2	9 min before HW	4.4	Cloud-free; drainage detail good inland, poor near coast; marsh detail excellent.
	2	5.3	2 hrs 16 min before HW	4.4	
	3	3.2	2 hrs 42 min after LW	1.6	

* 1 - Charleston Harbor; 2 - Woodville, S.C., Wando River; 3 - R. R. Bridge, west branch of the Cooper River.

TABLE 3

TIDAL INFORMATION CORRELATED WITH ERTS IMAGERY, NANTICOKE RIVER TEST SITE

#	ERTS IMAGE #	DATE	LOCATION	TIME REFERENCED TO TIDAL STAGE	TIDAL RANGE (ft.)	APPROX. TIDE HEIGHT (ft. above mean low water)	COMMENTS
1.	1062-15190	23 Sep. '72	*1	2 hrs. 19 min. A LW	3.0	0.9	marsh detail excellent
			*2	2 hrs. 20 min. A LW	3.2	0.9	some drainage detail
2.	1079-15133	10 Oct. '72	1	26 min. A LW	2.5	0.2	marsh detail excellent
			2	27 min. A LW	2.7	0.2	drainage detail excellent
3.	1080-15192	11 Oct. '72	1	3 min. B LW	1.9	0.3	marsh and drainage
			2	2 min. B LW	2.1	0.3	detail excellent
4.	1170-15193	9 Jan. '73	1	1 hr. 3 min. B LW	1.7	-0.1	snow within marsh
			2	1 hr. 2 min. B LW	1.9	-0.1	sandbar and ice visible
5.	1187-15140	26 Jan. '73	1	2 hrs. 38 min. A HW	1.7	1.3	little marsh detail
			2	2 hrs. 34 min. A HW	1.9	1.4	
6.	1205-15141	13 Feb. '73	1	14 min. B HW	2.1	2.3	little marsh detail
			2	18 min. B HW	2.3	2.5	ice and snow visible
7.	1295-15142	14 May. '73	1	1 hr. 56 min. B HW	2.0	1.7	some marsh detail
			2	2 hrs. B HW	2.2	1.6	thin cloud cover
8.	1313-15141	1 June '73	1	1 hr. 48 min. A LW	1.9	2.0	good marsh detail
			2	1 hr. 49 min. A LW	2.1	2.0	
9.	1349-15134	7 July '73	1	2 hrs. 53 min. A HW	2.0	1.4	excellent marsh detail
			2	2 hrs. 49 min. A HW	2.2	1.4	
10.	1385-15131	12 Aug. '73	1	2 hrs. 43 min. B HW	2.0	1.5	excellent marsh detail
			2	2 hrs. 47 min. B HW	2.2	1.4	some cloud cover
11.	1403-15125	30 Aug. '73	1	27 min. A LW	3.2	-0.2	excellent marsh detail
			2	28 min. A LW	3.4	-0.1	

*Location Tidal reference station: 1. Roaring Point, Md.; 2. Fishing Point, Fishing Bay.
Abbreviations: A, after; B, before; LW, low water; HW, high water.